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Editorial

Advanced control methods, which significantly enhance the performance and efficiency of mechatronic systems such as production machines or vehicles, are of vital importance to satisfy the growing customer demands regarding both flexibility and productivity. Traditional controllers have important limitations. Firstly, in many cases it is intricate or even impossible for the designers and operators to optimally tune the parameters of a traditional controller due to the complex nature and the vaguely known dynamics of the controlled system. Furthermore, traditional control algorithms are not able to track changing system dynamics and varying environmental conditions, which often appear in practical situations, and will consequently not adapt the control parameters accordingly. These drawbacks of traditional control algorithms, which result in suboptimal efficiency of the controlled machines and vehicles, can be solved by the introduction of learning behaviour in the controllers. This will allow systems to automatically learn the optimal control parameters and adapt to variations. Two types of learning algorithms can be distinguished. On the one hand, model-based learning algorithms rely on a model of the controlled system to update the control signal for the next trial. On the other hand, model-free learning algorithms directly learn a control policy for a given task, without the knowledge of a model of the system. The articles in this special issue provide interesting viewpoints on the benefits and drawbacks of both types of learning algorithms.

This special issue was set up in the framework of the Flemish research project LeCoPro (Learning Control for Production machines). In this project, funded by the agency for Innovation by Science and Technology in Flanders, Belgium, several research groups investigated the industrial applicability of learning control algorithms for production machines. This resulted in several successful implementations of learning control on industrial set-ups, which are presented in this special issue: the significant improvement of the engagement quality of a wet clutch and the accuracy of the motion of a tractor-implement combination, and the realisation of time optimal motions of a robot. Next to these results from the LeCoPro project, also results of other researchers active in the field of learning control are presented: e.g. on the control of a quadrocopter, wind turbines, a printer, a hydraulic excavator, etc. In our opinion, this special issue demonstrates the enormous potential of learning control for the mechatronic industry. We anticipate that the combination of theoretical and practical insights on learning control collected in this special issue will inspire many of you and we foresee a boom of learning control in many industrial applications in the coming years.

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